

What is claimed is:

1 1: A method comprising:
2 receiving a packet;
3 applying an Active Rule to the received Packet;
4 accessing a cached Condition Set Table, having at least one Condition Set,
5 associated with the Active Rule;
6 for each Condition Set, having at least one Condition, in the Condition Set Table,
7 evaluating the Condition(s) in the Condition Set, and
8 determining if the Condition Set is met;
9 determining if the Active Rule is met; and
10 executing an Action Set associated with the Active Rule.

1 2: The method of claim 1, wherein applying an Active Rule to the received Packet
2 includes:
3 parsing a cached Rules Tables, having a plurality of rules, to determine if a rule is
4 pertinent to the received packet;
5 if so, making the pertinent rule the Active Rule.

1 3: The method of claim 2, wherein applying an Active Rule to the received Packet
2 includes:
3 if more than one rule in the Rules Table is pertinent, performing the method of
4 claim 1 for each pertinent rule.

1 4: The method of claim 2, wherein the received packet includes a source, a destination,
2 and a protocol;
3 wherein the rules in the Rules Table includes a source, a destination, and a
4 protocol; and
5 wherein determining if a rule is pertinent to the received packet includes:
6 determining if the source of the received packet and the source of the rule are equivalent;
7 determining if the destination of the received packet and the destination of the rule are
8 equivalent;
9 determining if the protocol of the received packet and the protocol of the rule are
10 equivalent;
11 if all three are equivalent, considering the rule pertinent to the received packet.

1 5: The method of claim 2, wherein applying an Active Rule to the received Packet
2 includes:
3 selecting a rule from a Rules Table, having at least one rule; and
4 accessing a Rule Group from a Rules Group Table;
5 wherein the Rule Group includes a field to facilitate access to the first Condition Set
6 associated with the rule, and a field to facilitate access to the first Action Set associated
7 with the rule.

1 6: The method of claim 5, wherein accessing a cached Condition Set Table includes:
2 accessing the Condition Set Tables utilizing the Rule Group's field to facilitate
3 access to the first Condition Set associated with the rule.

1 7: The method of claim 1, wherein each of the at least one Conditions includes pattern,
2 and an opcode; and
3 wherein evaluating the Condition(s) in the Condition Set includes:
4 for each Condition,
5 comparing the pattern to the received packet in the manner dictated by the
6 opcode, and
7 producing a Boolean value as a result of the comparison; an
8 wherein determining if the Condition Set is met includes:
9 computing a single Boolean value utilizing the Boolean values resulting from
10 evaluating the Condition(s).

1 8: The method of claim 7, wherein each of the at least one Conditions further includes at
2 least one of the fields selected from a group including of the following:
3 a bit offset where the pattern is to be found,
4 a pattern mask to alter interpretation of the pattern,
5 a mask value to alter interpretation of received packet, and
6 a pattern length.

1 9: The method of claim 7, wherein each of the at least one Conditions further includes a
2 flag to denote that the Condition has already been evaluated for the current received
3 packet, and a value denoting the result of that evaluation.

1 10: The method of claim 7, wherein computing a single Boolean value utilizing the
2 Boolean values resulting from evaluating the Condition(s) includes:
3 utilizing a 1-bit Condition Accumulator to logically AND, as each Condition's
4 Boolean value is computed, the Boolean values resulting from evaluating the
5 Condition(s).

1 11: The method of claim 7, wherein determining if the Active Rule is met includes:
2 computing a single Boolean value utilizing the Boolean values resulting from
3 determining if the Condition Set is met.

1 12: The method of claim 11, wherein computing a single Boolean value utilizing the
2 Boolean values resulting from determining if the Condition Set is met includes:
3 utilizing a 1-bit Condition Set Accumulator to logically OR, as each Condition
4 Set's Boolean value is computed, the Boolean values resulting from determining if the
5 Condition Set is met.

1 13: The method of claim 6, wherein evaluating the Condition(s) in the Condition Set
2 includes:
3 utilizing the Condition Set Table to access a Condition Indirection Table, having a
4 pointer to each Condition, wherein the pointers are grouped by Condition Set; and
5 utilizing the pointers to access a Condition Table having the Conditions.

1 14. The method of claim 13, wherein any Condition may be included by a plurality of
2 Condition Sets.

1 15. The method of claim 13, wherein the Condition Indirection Table is stored within a
2 Content Addressable Memory (CAM).

1 16. The method of claim 1, wherein executing an Action Set associated with the Active
2 Rule includes:
3 accessing an Action Set having at least one Action; and
4 executing each Action within the Action Set.

1 17. The method of claim 16, wherein executing each Action includes performing one of
2 the Actions selected from a group including the following:

3 altering the packet header,
4 altering the packet contents,
5 reporting information to a third party, and
6 changing the priority status of the packet.

1 18. The method of claim 16, wherein accessing an Action Set having at least one Action
2 includes:

3 accessing a Rule Group having a pointer to the Action Set;
4 accessing an Action Set Table having a plurality of Action Sets; and
5 selecting an Action Set from the Action Set Table.

1 19. The method of claim 1, wherein the number of Conditions in a Condition Set is
2 limited, at least in part, by the amount of information that can be read from a cache
3 memory in one clock cycle.

1 20. The method of claim 1, wherein the number of Actions in an Action Set is limited, at
2 least in part, by the amount of information that can be read from a cache memory in one
3 clock cycle.

1 21. An apparatus comprising:
2 a micro-engine having a rule based action packet processing engine that is capable
3 of processing a received packet;
4 a network processor core that is capable of resource management and control of
5 the micro-engine;
6 a packet buffer to receive a packet; and
7 a cache memory to store data structures for the micro-engine.

1 22. The apparatus of claim 21, further including a plurality of micro-engines to process a
2 plurality of received packets substantial simultaneously.

1 23. The apparatus of claim 21, wherein the micro-engine includes:
2 an ingress packet processing engine to receive a packet;
3 an egress packet processing engine to forward a processed packet; and
4 a Rule Based Action Packet Processing Engine that is capable of:
5 applying an Active Rule to the received Packet;
6 accessing a cached Condition Set Table, having at least one Condition Set, associated
7 with the Active Rule;
8 for each Condition Set, having at least one Condition, in the Condition Set Table,
9 evaluating the Condition(s) in the Condition Set, and
10 determining if the Condition Set is met;

- 11 determining if the Active Rule is met; and
- 12 executing an Action Set associated with the Active Rule.

- 1 24. The apparatus of claim 23, wherein the Rule Based Action Packet Processing
- 2 Engine's capability to apply an Active Rule to the received Packet includes the capability
- 3 to:
 - 4 parse a cached Rules Tables, having a plurality of rules, to determine if a rule is
 - 5 pertinent to the received packet;
 - 6 if so, make the pertinent rule the Active Rule.

- 1 25. The apparatus of claim 24, wherein the received packet includes a source, a
- 2 destination, and a protocol;
 - 3 wherein the rules in the Rules Table includes a source, a destination, and a
 - 4 protocol; and
 - 5 wherein the Rule Based Action Packet Processing Engine's is capable of:
 - 6 determining if the source of the received packet and the source of the rule are equivalent;
 - 7 determining if the destination of the received packet and the destination of the rule are
 - 8 equivalent;
 - 9 determining if the protocol of the received packet and the protocol of the rule are
 - 10 equivalent;
 - 11 if all three are equivalent, considering the rule pertinent to the received packet.

1 26: The apparatus of claim 24, wherein the Rule Based Action Packet Processing
2 Engine's is capable of, when applying an Active Rule to the received Packet:
3 selecting a rule from a Rules Table, having at least one rule; and
4 accessing a Rule Group from a Rules Group Table;
5 wherein the Rule Group includes a field to facilitate access to the first Condition Set
6 associated with the rule, and a field to facilitate access to the first Action Set associated
7 with the rule.

1 27: The apparatus of claim 23, wherein each of the at least one Conditions includes
2 pattern, and an opcode; and
3 wherein the Rule Based Action Packet Processing Engine's is capable of, when
4 evaluating the Condition(s) in the Condition Set:
5 for each Condition,
6 comparing the pattern to the received packet in the manner dictated by the
7 opcode, and
8 producing a Boolean value as a result of the comparison; an
9 wherein determining if the Condition Set is met includes:
10 computing a single Boolean value utilizing the Boolean values resulting from
11 evaluating the Condition(s).

1 28: The apparatus of claim 27, wherein the Rule Based Action Packet Processing Engine
2 includes a 1-bit Condition Accumulator; and
3 the Rule Based Action Packet Processing Engine is capable of, when computing a single
4 Boolean value utilizing the Boolean values resulting from evaluating the Condition(s):
5 utilizing the 1-bit Condition Accumulator to logically AND, as each Condition's
6 Boolean value is computed, the Boolean values resulting from evaluating the
7 Condition(s).

1 29: The apparatus of claim 27, wherein the Rule Based Action Packet Processing Engine
2 is capable of, when determining if the Active Rule is met:
3 computing a single Boolean value utilizing the Boolean values resulting from
4 determining if the Condition Set is met.

1 30: The apparatus of claim 29, wherein the Rule Based Action Packet Processing Engine
2 includes a 1-bit Condition Set Accumulator; and
3 the Rule Based Action Packet Processing Engine is capable of, when computing a single
4 Boolean value utilizing the Boolean values resulting from determining if the Condition
5 Set is met:
6 utilizing the 1-bit Condition Set Accumulator to logically OR, as each Condition
7 Set's Boolean value is computed, the Boolean values resulting from determining if the
8 Condition Set is met.

1 31: The apparatus of claim 23, wherein the Rule Based Action Packet Processing Engine
2 is capable of
3 accessing the Condition Set Tables utilizing the Rule Group's field to facilitate
4 access to the first Condition Set associated with the rule
5 utilizing the Condition Set Table to access a Condition Indirection Table, having a
6 pointer to each Condition, wherein the pointers are grouped by Condition Set; and
7 utilizing the pointers to access a Condition Table having the Conditions; and
8 wherein the Condition Set Table is stored as a data structure within the cache memory.

1 32: The apparatus of claim 31, wherein Micro-Engine includes a Content Addressable
2 Memory (CAM); and
3 the Condition Indirection Table is stored within the Content Addressable Memory.

1 33: The apparatus of claim 23, wherein the Rule Based Action Packet Processing Engine
2 is capable of, when executing an Action Set associated with the Active Rule:
3 accessing an Action Set having at least one Action; and
4 executing each Action within the Action Set; and
5 the Action Set is stored a data structure within the cache memory.

1 34: The apparatus of claim 33, wherein the Rule Based Action Packet Processing Engine
2 is capable of performing one of the Actions selected from a group including the
3 following:

4 altering the packet header,
5 altering the packet contents,
6 reporting information to a third party, and
7 changing the priority status of the packet.

1 35: The apparatus of claim 33, wherein the Rule Based Action Packet Processing Engine
2 is capable of, when accessing an Action Set:
3 accessing a Rule Group having a pointer to the Action Set;
4 accessing an Action Set Table having a plurality of Action Sets; and
5 selecting an Action Set from the Action Set Table.

1 36: The apparatus of claim 23, wherein the number of Conditions in a Condition Set is
2 limited, at least in part, by the amount of information that can be read from a cache
3 memory in one clock cycle.

1 37: The apparatus of claim 23, wherein the number of Actions in an Action Set is
2 limited, at least in part, by the amount of information that can be read from the cache
3 memory in one clock cycle.

1 38: The apparatus of claim 35, wherein the cache memory includes a SRAM.

1 39: The apparatus of claim 38, wherein the packet buffer includes a DRAM.

1 40: The apparatus of claim 39, wherein the network processor core is further capable of
2 receiving instructions via a generic programmable interface; and
3 the received instructions are capable of altering the Condition Set and the Action
4 Set.

1 41: An article comprising:
2 a storage medium having a plurality of machine accessible instructions, wherein when the
3 instructions are executed, the instructions provide for:
4 receiving a packet;
5 applying an Active Rule to the received Packet;
6 accessing a cached Condition Set Table, having at least one Condition Set,
7 associated with the Active Rule;
8 for each Condition Set, having at least one Condition, in the Condition Set Table,
9 evaluating the Condition(s) in the Condition Set, and
10 determining if the Condition Set is met;

11 determining if the Active Rule is met; and
12 executing an Action Set associated with the Active Rule.

1 42: The article of claim 41, wherein the instructions providing for applying an Active
2 Rule to the received Packet includes instructions providing for:
3 parsing a cached Rules Tables, having a plurality of rules, to determine if a rule is
4 pertinent to the received packet;
5 if so, making the pertinent rule the Active Rule.

1 43: The article of claim 42, wherein the instructions providing for applying an Active
2 Rule to the received Packet includes instructions providing for:
3 if more than one rule in the Rules Table is pertinent, performing the method of
4 claim 1 for each pertinent rule.

1 44: The article of claim 42, wherein the received packet includes a source, a destination,
2 and a protocol;
3 wherein the rules in the Rules Table includes a source, a destination, and a
4 protocol; and
5 wherein the instructions providing for determining if a rule is pertinent to the
6 received packet includes instructions providing for:
7 determining if the source of the received packet and the source of the rule are equivalent;

8 determining if the destination of the received packet and the destination of the rule are
9 equivalent;
10 determining if the protocol of the received packet and the protocol of the rule are
11 equivalent;
12 if all three are equivalent, considering the rule pertinent to the received packet.

1 45: The article of claim 42, wherein the instructions providing for applying an Active
2 Rule to the received Packet includes instructions providing for:
3 selecting a rule from a Rules Table, having at least one rule; and
4 accessing a Rule Group from a Rules Group Table;
5 wherein the Rule Group includes a field to facilitate access to the first Condition Set
6 associated with the rule, and a field to facilitate access to the first Action Set associated
7 with the rule.

1 46: The article of claim 45, wherein the instructions providing for accessing a cached
2 Condition Set Table includes instructions providing for:
3 accessing the Condition Set Tables utilizing the Rule Group's field to facilitate
4 access to the first Condition Set associated with the rule.

1 47: The article of claim 41, wherein each of the at least one Conditions includes pattern,
2 and an opcode; and

3 wherein the instructions providing for evaluating the Condition(s) in the Condition Set
4 includes instructions providing for:
5 for each Condition,
6 comparing the pattern to the received packet in the manner dictated by the
7 opcode, and
8 producing a Boolean value as a result of the comparison; an
9 wherein determining if the Condition Set is met includes:
10 computing a single Boolean value utilizing the Boolean values resulting from
11 evaluating the Condition(s).

1 48: The article of claim 47, wherein each of the at least one Conditions further includes
2 at least one of the fields selected from a group including of the following:
3 a bit offset where the pattern is to be found,
4 a pattern mask to alter interpretation of the pattern,
5 a mask value to alter interpretation of received packet, and
6 a pattern length.

1 49: The article of claim 47, wherein each of the at least one Conditions further includes a
2 flag to denote that the Condition has already been evaluated for the current received
3 packet, and a value denoting the result of that evaluation.

1 50: The article of claim 47, wherein the instructions providing for computing a single
2 Boolean value utilizing the Boolean values resulting from evaluating the Condition(s)
3 includes instructions providing for:
4 utilizing a 1-bit Condition Accumulator to logically AND, as each Condition's
5 Boolean value is computed, the Boolean values resulting from evaluating the
6 Condition(s).

1 51: The article of claim 47, wherein the instructions providing for determining if the
2 Active Rule is met includes instructions providing for:
3 computing a single Boolean value utilizing the Boolean values resulting from
4 determining if the Condition Set is met.

1 52: The article of claim 51, wherein the instructions providing for computing a single
2 Boolean value utilizing the Boolean values resulting from determining if the Condition
3 Set is met includes instructions providing for:
4 utilizing a 1-bit Condition Set Accumulator to logically OR, as each Condition
5 Set's Boolean value is computed, the Boolean values resulting from determining if the
6 Condition Set is met.

1 53: The article of claim 46, wherein the instructions providing for evaluating the
2 Condition(s) in the Condition Set includes instructions providing for:

3 utilizing the Condition Set Table to access a Condition Indirection Table, having a
4 pointer to each Condition, wherein the pointers are grouped by Condition Set; and
5 utilizing the pointers to access a Condition Table having the Conditions.

1 54. The article of claim 53, wherein any Condition may be included by a plurality of
2 Condition Sets.

1 55. The article of claim 53, wherein the Condition Indirection Table is stored within a
2 Content Addressable Memory (CAM).

1 56. The article of claim 41, wherein the instructions providing for executing an Action
2 Set associated with the Active Rule includes instructions providing for:
3 accessing an Action Set having at least one Action; and
4 executing each Action within the Action Set.

1 57. The article of claim 56, wherein the instructions providing for executing each Action
2 includes instructions providing for performing one of the Actions selected from a group
3 including the following:
4 altering the packet header,
5 altering the packet contents,

6 reporting information to a third party, and
7 changing the priority status of the packet.

1 58. The article of claim 56, wherein the instructions providing for accessing an Action
2 Set having at least one Action includes instructions providing for:
3 accessing a Rule Group having a pointer to the Action Set;
4 accessing an Action Set Table having a plurality of Action Sets; and
5 selecting an Action Set from the Action Set Table.

1 59. The article of claim 41, wherein the number of Conditions in a Condition Set is
2 limited, at least in part, by the amount of information that can be read from a cache
3 memory in one clock cycle.

1 60. The article of claim 41, wherein the number of Actions in an Action Set is limited, at
2 least in part, by the amount of information that can be read from a cache memory in one
3 clock cycle.